eg. 1. You lift a 1.0 kg mass up 1.0m. You could also use a pulley to lift the mass. You exert 12N on a string to lift the mass the same distance. What is the efficiency of the pulley?

efficiency = Wout/Win x 100%
= $F_{out}d_{out}/F_{in}d_{in}$ x100%
= 1.0kg x 9.8N/kg x1.0m /12Nx1.0m x 100% =
9.8/12=0.8167 =82%

1. You leave a 100 W light bulb on for 8 hours a day for a year. If BC Hydro charges 10 cents per kilowatt-hour, how much does it cost to have the bulb on? If you replace the bulb with high efficiency bulb that only uses 25W to give the equivalent light, how much money do you save a year?

   100Wx8h/dx365.25d (1kW/1000W)
   0.1x8x365.25=292.2 kWhrs
   $29 a year.

   0.75x29.22=21.915 you save $22/year

2. Run up the stairs and determine your power.

   P=W/t = Fd/t = mgh/t

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Energy
Why can't you have efficiency over 100%?
Because of the first law of Thermodynamics - law of conservation of energy.
Energy can't be created or destroyed, it only changes form. (Einstein added mass to forms of energy $E=mc^2$)

What is energy?
energy is the potential to do physical work

what is work?
causes changes in energy - circular argument
physical work - vector dot product of F and s.

https://www.youtube.com/watch?v=7zy-zfLB4jI
https://www.youtube.com/watch?v=BVxEEn3w688&feature=fvw
http://techtv.mit.edu/videos/1491-potential-energy-to-kinetic-energy

Big idea - swinging mass - gravitational energy, E_g, is transformed into kinetic energy, E_k.

derive equation using work-energy theorem
change in energy = Work

$\Delta E = W$ = area under F-s graph

Kinetic energy, E_k is the energy of motion.
$W = Fs$
changes in motion require a net force
$W_{net} = F_{net}\, s = mas$
$v^2 = u^2 + 2as \quad as = 1/2(v^2 - u^2)$
$W_{net} = m \times 1/2(v^2 - u^2) = 1/2mv^2 - 1/2mu^2$
= change in energy = energy final - energy initial
so
$E_k = 1/2mv^2$

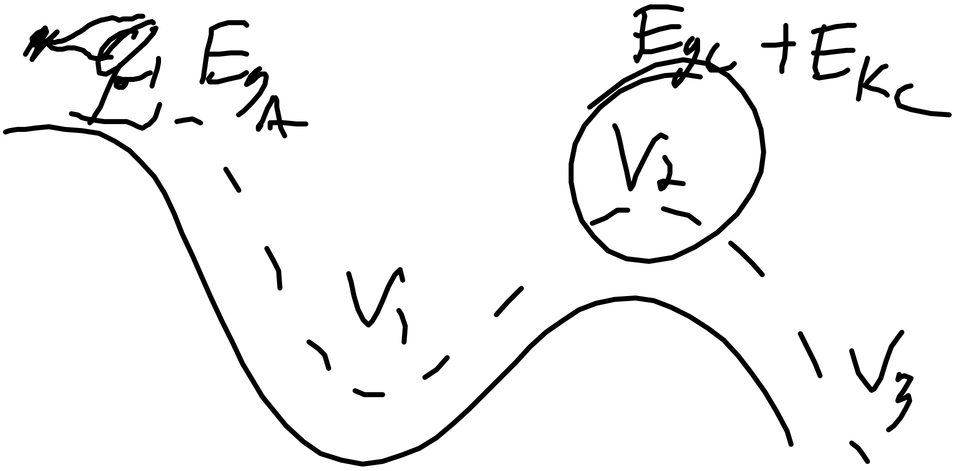
How about gravitational energy, E_g?
define gravitational energy as the work done against gravity from a reference point.
$W_g = F_g s$ if g is constant   - like near Earth
$W_g = mgs$ where s is up
$W_g = mg\Delta h = Egf - Egi$
$E_g = mgh$ - near earth relative to h=0 as reference point.

keeners
W_g = integral of $Fg = GMm/r^2$ dr from infinity to r.
go over next class

eg. You ski down a fricitonless slope from a height of 8.0m and up a hill height 4.0m. If you start from rest, m = 105kg
a) what is your gravitational energy at the top of each

hill?
Eg=mgh = 105kgx9.81N/kg(8 or 4)
4.1 kJ or 8.2kJ

b) kinetic energy at the bottom of each hill and the top of the second hill?
bottom all the Eg=Ek   8240.4 = 1/2(105kg)v^2
v= Sqrt(8240.4x2/105)=12.52836781069266
v=13m/s



$V_1 = V_3$ if no friction

$E_{gA} = E_{gc} + E_{kc}$

$mgh_A = mgh_c + \frac{1}{2}mv_2^2$

$V_2 = 8.9 m/s$

c) How much energy is lost to resistive forces if your speed at the top of the second hill is 1.0 m/s?

$\sum E_{initial} = \sum E_{final}$

$mgh_A = mgh_c + \frac{1}{2}mv^2 + E_{Lost}$

$105(9.8)(8) = 105(9.8)(4) + \frac{1}{2}(105)(1)^2 + E_{Lost}$

$E_{int} = 4063\ J$

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problems 31, 37, 43, 51, 61, 65, 87,